1907

U. S. GEOLOGICAL SURVEY
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To the Director of the
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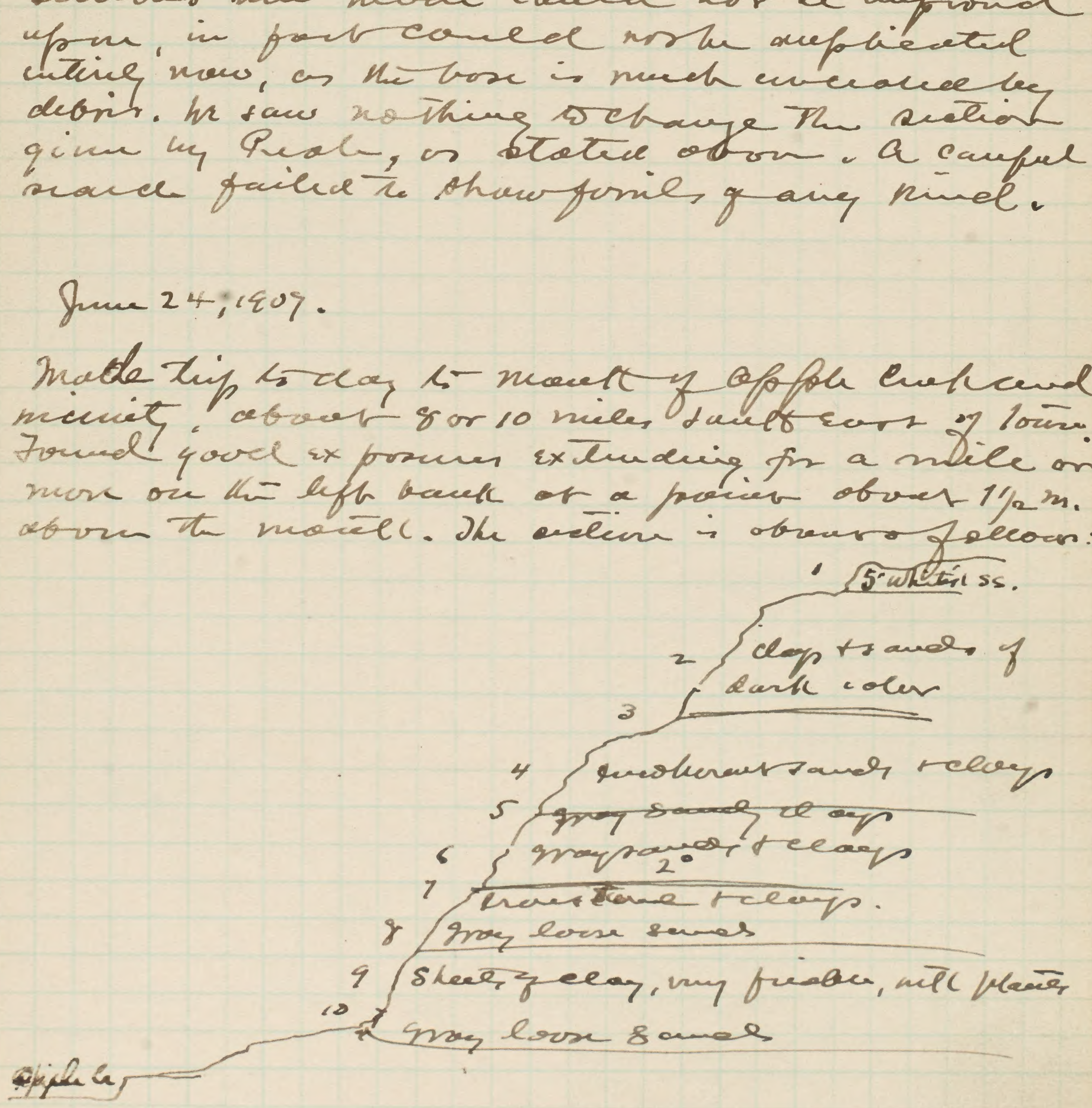
6—241

Bismarck, N. Dak. June 23, 1907.

This a.m. went out several miles north of the town but found no exposures other than thru the loess or glacial deposits.
In the afternoon we went out west for about 2 miles to the railroad bridge over the Missouri. Here we saw the cuts made by the railroad just before passing onto the bridge. These cuts were visited by Dr. Peale in 1884 and his sections there made could not be improved upon, in fact could not be duplicated entirely now, as the base is much covered by debris. We saw nothing to change the section given by Peale, or stated above. A careful search failed to show fossils of any kind.

June 24, 1907.

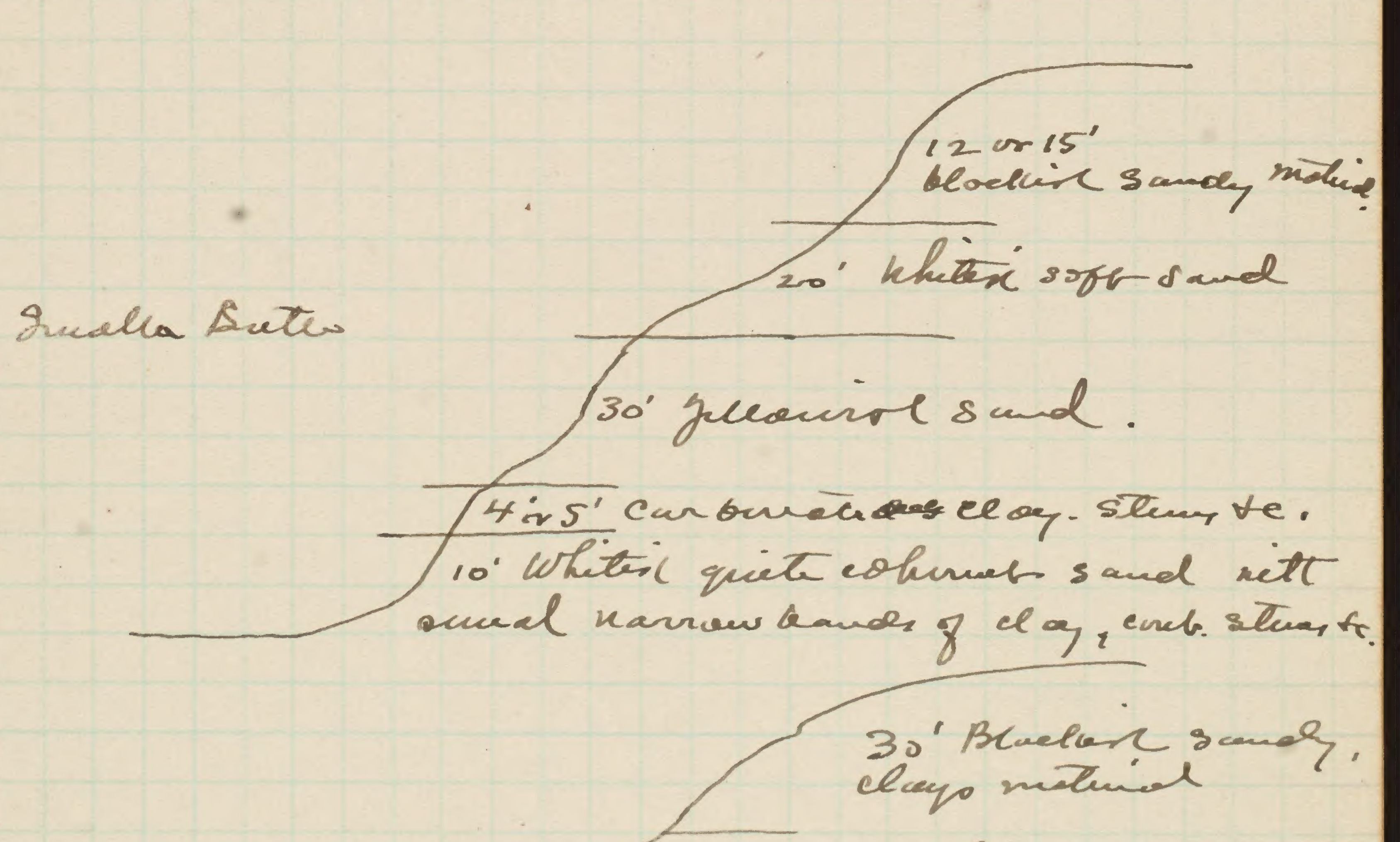
Made trip to day to mouth of Apple Creek and vicinity, about 8 or 10 miles south east of town. Found good exposures extending for a mile or more on the left bank at a point about 1½ m. above the mouth. The section is about as follows:

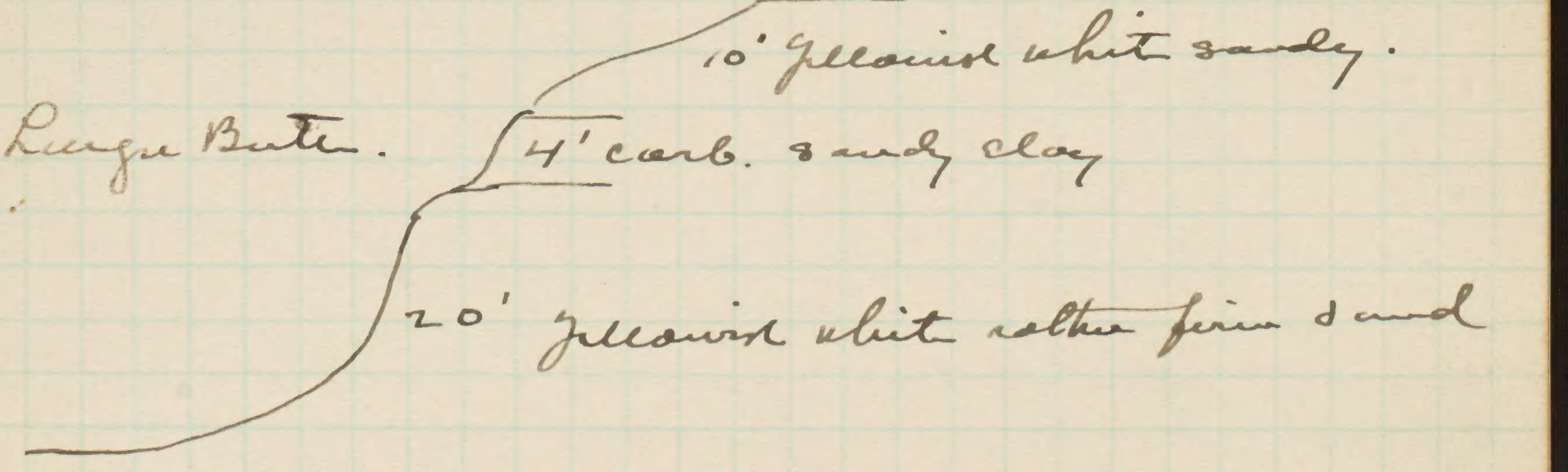

1
5' white ss.
2
clays + sands of dark color
3
4
carbonaceous sands + clays
5
~~gray sandy clays~~
6
gray sands + clays
2°
7
ironstone + clays.
8
gray loose sand
9
Sheets of clay, very friable, with plants
10
gray loose sand
Apple Cr.

In no 9 of above section which is only a few inches thick and composed of extremely friable clay shales, we found a considerable number of fossil plants, among them the following genera: Fern (cf Adiantum), Salix, Ficus, Quercus, Laurus?, Fruit?, finely serrate-marginal dicotyledon small leaf, probably Rosa? microphylla, but too imperfect to be certain. All these plants are so very rotten that it is doubtful if they will carry to Wash.

From the above mentioned exposures went down to the Missouri about a mile below the mouth of Apple Creek, where the bluff is well exposed for some distance. It is almost vertical and probably about 70 or 75 feet in height, but owing to high water we could not get down along its base. It appeared to be composed of alternating loose sands and clays, with no evidence of lignite in it. A careful search of above region was made and no seam or piece of lignite being noted in this bluff, nor had any fossils been observed.

From this point went about 2 m. S.E. to visit two more buttes which can be seen for some distance. The smaller shows the following section (est.)


Smaller Butte
12 or 15' blackish sandy material
20' Whitish soft sand
30' Yellowish sand.
4 or 5' carbonaceous clay. streaks &c.
10' Whitish quite coherent sand with several narrow bands of clay, carb. streaks &c.


Large Butte.
30' Blackish sandy, clays material
10' Yellowish white sandy.
4' carb. sandy clay
20' Yellowish white rather firm sand

These buttes contain a band 4 or 5' thick of a carbonaceous clay which contained numerous stems & fragments of plants but nothing determinable. No shells or bones could be found.

June 25. Visited exposures along Burnt Creek about 5 or 6' north west of Bismarck, and beyond Ward's ranch. The exposures are very poor showing but little, but so far as could be made out the beds were 30-40' higher than the beds observed at the Missouri River bridge. No fossils of any kind were observed.

June 27. Spent the day on the exposures along Apple Creek north of the small bridge just beyond Ft. Lincoln. In general appearance the beds are very similar to the exposures observed near the mouth of Apple Creek, though the section undoubtedly includes higher beds.

June 28. Left Bismarck this am. via Soo line for Coal Harbor, which was reached at 1^{10}. The distance is about 65 miles, the R.R. passing most of the way over the bluffs or rather upper table land. The fact that two geological areas was passed over was particularly noted by the change in the vegetation. Just below the town of Washburn the surface soil becomes lighter in color, apparently more sandy in character and supports a different series of plants. Although there appears to have been plenty of rain this season, the crops and general appearance is decidedly inferior to that noted about Bismarck and along the R.R. to the point indicated above. If our inference is correct these upper lands represent the Fort Union and the lower areas (about Bismarck etc) the [illegible] beds studied the past few days.

We found no outcrop at Coal Harbor except a very small one in the R.R. cut about 1/2 mile East of the depot. This showed about 10 or 12 feet of horizontally bedded sand - probably of glacial origin.

Dickinson, N.D. July 2, 1907.

Spent the entire day in studying and collecting from the dump and mines of the Brick Co., about 1 mile southwest of the town. From the pile of clay as brought to the plant we collected a considerable number of fairly well preserved leaves, such as Populus arctica, P. Hurii? etc. On the banks of Heart River just below the plant the company is mining lignite from a vein 6 or 7' feet in thickness, which has a slight dip to the north. We were told that occasional plants were found in association with the lignite, but we failed to detect any, though in a layer about 1 foot above we found masses of leaves. These could not be taken however, as the clay is very carbonaceous and much too soft and friable to hold together. The leaves are so matted together that it was impossible to identify them, though there were minute fragments of coniferous branchlets, probably a small short-leaved Sequoia.

In the afternoon we visited the clay banks about 1 to 1½ miles S.W. of the plant where the supply of clay for the works comes. We had no difficulty in identifying the horizon whence came the material collected at the works. [illegible] placing it in Leonard's section of the place. (cf. pp. 160-161 of his 3d Rept.). In No 10 of his section — a blue fine-grained clay — we found beautifully preserved leaves, all however, belonging to the genus Populus. They seem to be P. cuneata & P. amblyrhyncha or something near these. The other plants came from the same bed but nearer the top. In the office of the Brick Co. we were shown a fine leaf of Aralia Whitneyi which was said to have come from the same bed as that which afforded our best Populus leaves — i.e. lower portion of No 10 as indicated above.

The section given by Leonard embraces about 95 feet and could have been carried about as much higher by going to the flat-topped buttes a mile or more to the south; this we did not do for lack of time.
[This was carried up by Dr. Peale who found approximately 150'. See his section.]

July 6. Medora, N.D.
Visited the camp of C.D. Smith July 5—
We were taken by Mr. Smith to a plant locality about 2 miles up the river from the railroad bridge — on the west side in a bluff facing the river. The plants occur in a loose seemingly of limestone but probably only a hardened sandstone. It is of a yellow color, very hard and breaking with a conchoidal fracture. It is about 15-18 feet above the main coal seam, and is of limited extent laterally. The plants are very abundant and splendidly preserved. Made a large collection among which I recognize the following species: Platanus nobilis, Populus cuneata, P. arctica, P. amblyrhyncha, Phyllites cupanioides, Hicoria antiquorum, Rhamnus concinnus, Viburnum sp., Juglans sp. possibly Sapindus.

At a point about a mile north slightly west of the above mentioned point we were taken to another splendid locality which is about 20 feet above the second ~~coal~~ seam of lignite or about -- feet above the first. Specimens beautifully preserved and abundant.

July 12. Custer Trail Ranch 4 m. S. of Medora

Collected plants from several points in the bluffs west and north of the ranch. In burned shale just above the main coal seam at a point about ½ mile southeast of the mouth of Davis Creek (SE¼ sec 3), found and collected numerous examples of Populus cuneata. Nothing but this species could be found in these beds. At the same locality and at a point about 20 feet above the burned clay found numerous remains of Equisetum and Cabomba, with nothing else. The Equisetum shows the roots, fine rootlets and aerial nodes.

In the bluff in front of the ranch house at a point about 10 or 15 feet above the middle (4') seam of coal, found a lens of limestone that contained a few plants. The only ones determinable were Corylus americana and Aralia notata. This is about on the same level as locality No. , and contains the same species so far as they go.

About one mile SE of the ranch, on Davis Creek, and in clay just above the upper seam of coal (180' above the river) found Asplenium tenerum in abundance. It is not fruiting but is beautifully preserved.

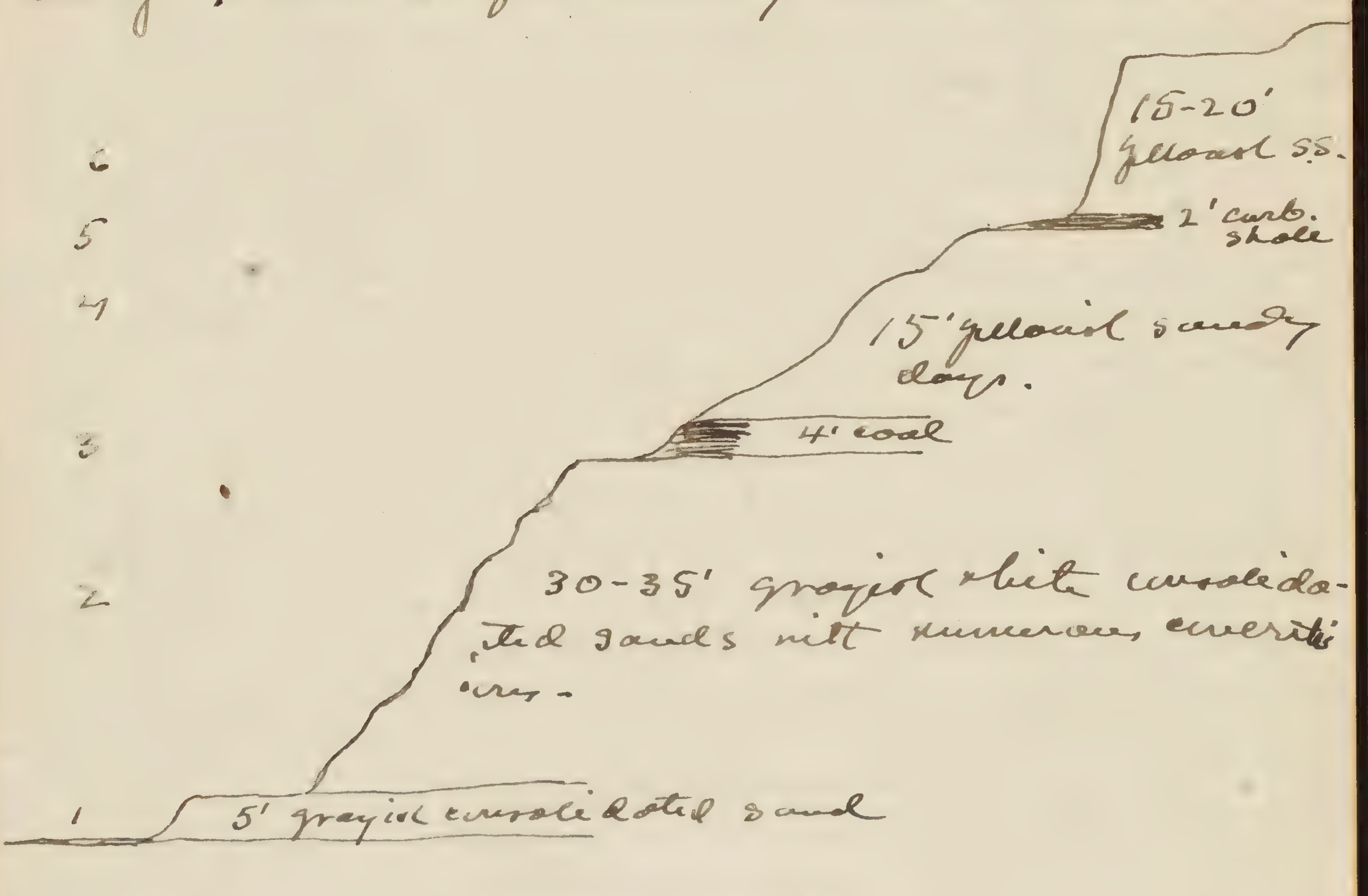
July 13. To day visited the Foley ranch, which is about 9 miles SW of Medora, and were taken to the bone locality about 4 miles further S.W. At a point near the top of the highest bluffs in the vicinity and some 400' feet above the Little Missouri river we found the bones. They occur in or just above a 2" or 3" seam of coal in the floor of a small basin and probably in the surrounding bluff exposures as well. We found vertebrae of two sizes, spines, a poorly preserved skull, and some larger bones; no plants. Bones sent at once to Gidley. This point is in the midst of undoubted Ft. Union, and some 150-200' higher than the exposures of typical Ft. Union about Medora.

July 15. Sentinel Butte, N.D.
Ascended this Butte to day, collecting leaves and other plant remains from 5 horizons, with well preserved fish in the 20' of white fossiliferous shales on the extreme top [Position of plants etc., shown on Peale's copy of Leonard's section].

July 16. Glendive, Montana.
Spent afternoon in bluffs south of town. In lowest beds found a carbonaceous layer containing stems, fragments of dicot. leaves etc., and one good leaf which I recognized as a small leaf of Aralia notata. A few feet above this bed found numerous bones, plates of turtles etc. [For details as to position of plants & bones see Peale's sections of 1884 & 1907].

July 17. Glendive, Mont.
Spent forenoon on the bluffs just south of town searching for plants. Found only seeds and stems at a point indicated in Peale's section q.v. At a horizon above that containing the seeds and just under a thick whitish or grayish sandstone, found additional bones, among them vertebrae of two sizes, long slender limb bones as well as plates of turtles etc.

In afternoon I visited the bluffs on the N. side of the Yellowstone and about 3 miles NW. of the bridge, where the following section is exhibited:

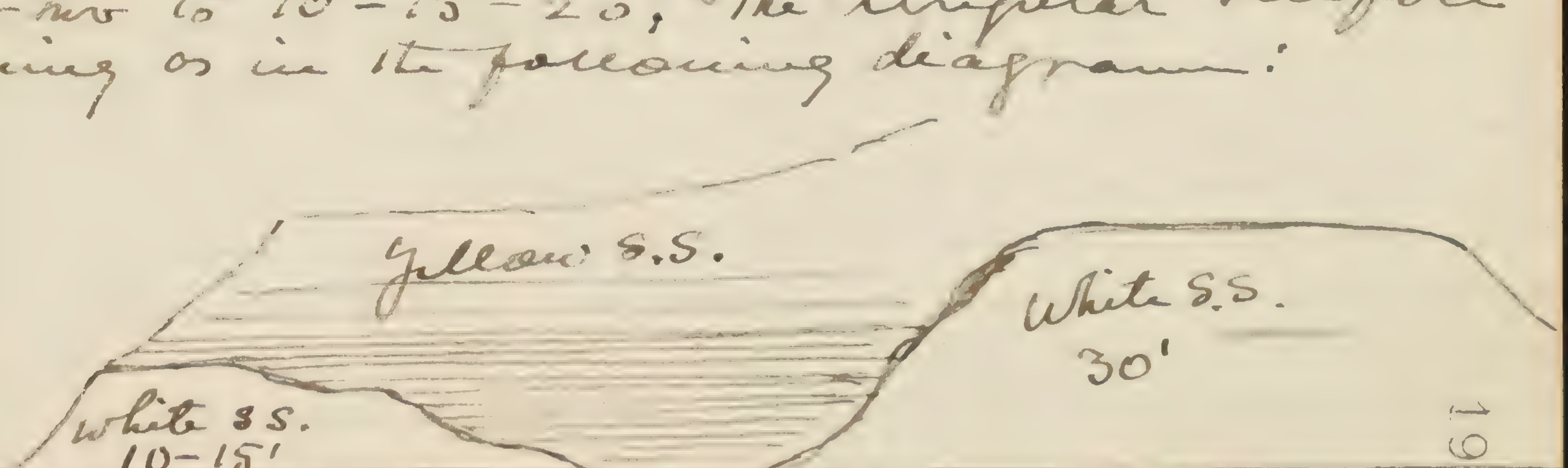

6
5
4
3
2
1
15-20' yellowish SS.
2' carb. shale
15' yellowish sandy clays.
4' coal
30-35' grayish white unconsolidated sands with numerous concretions.
5' grayish unconsolidated sand

This section is clearly higher than that in the bluffs south of town, that is the base is approximately in the position of No , in Peale's section of the latter. The grayish unconsolidated sands at the base weather as in the latter, and are also filled with harder concretions. Just above these (No 2) is a bed of rather poor coal about 4' thick wh. is burned out in many places, it has been mined at numerous points in the past, but the workings have all fallen in and it is now entirely abandoned. With exception of a single leaflet have found nothing but stems above the main coal.

In the 2' layer of highly carbonaceous matter (No. 5) found remains of Ginkgo interrupta, Sequoia nordenskiöldi, Onoclea sensibilis and minute fragments of dicotyledons

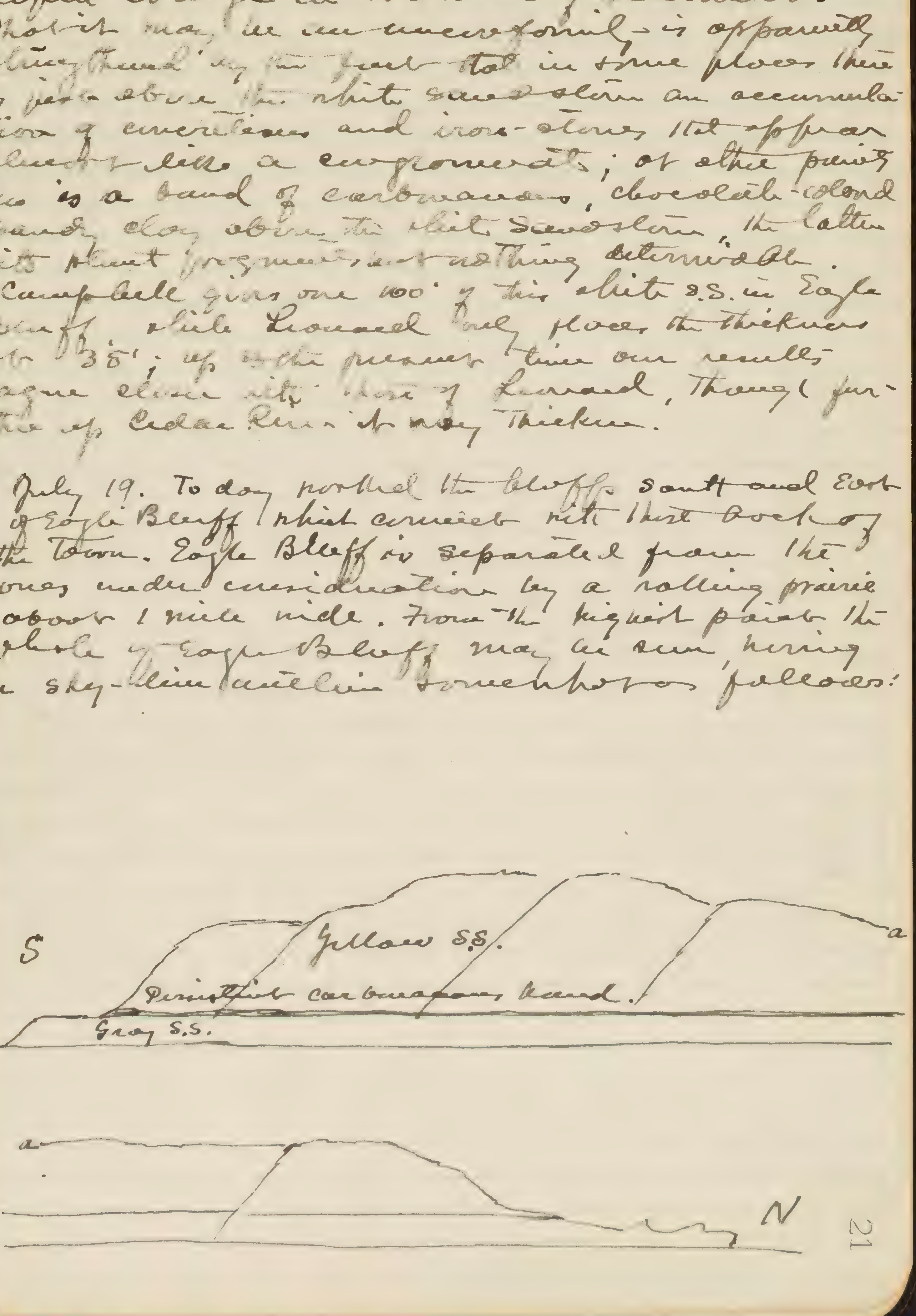
July 18. To day visited the bluffs on the north end of Eagle Bluff, about 2 miles west of the town of Glendive, and at the point near the first cut on the N.P. railroad. The exact point is on the N side of the railroad and just west of the dry creek crossing the R.R. The basal member exposed here is a white coarse-grained friable sandstone, above which is a bed of yellowish S.S. with numerous irregular lenses and concretions. At this place the white sandstone is about 10' thick and from the upper 5 or 6' obtained a good collection of beautifully preserved leaves, representing the following genera: Platanus, Quercus, Laurus, Rhamnus and probably Salix. This flora is unlike any seen thus far and may be Laramie [Lot No. 4]

Following these bluffs for a mile or more in a S.W. direction, until they turn up the valley of Cedar Creek, it was noted that the white sandstone changed greatly in thickness, reaching its maximum near the crossing and of the railroad cut where it is approximately 30', while at other points it ranges from only a foot or two to 10-15-20'; the irregular surface being as in the following diagram:



This appears like a case of erosional unconformity, though it may possibly be only a rapid change in character of sediment. That it may be an unconformity is apparently strengthened by the fact that in some places there is just above the white sandstone an accumulation of concretions and iron-stones that appear almost like a conglomerate; at other points there is a band of carbonaceous, chocolate-colored sandy clay above the white sandstone, the latter with plant fragments but nothing determinable. Campbell gives one 100' of this white S.S. in Eagle Bluff, while Leonard only places the thickness at 38'; up to the present time our results agree closely with those of Leonard, though further up Cedar River it may thicken.

July 19. To day worked the bluffs south and East of Eagle Bluff which connect with those back of the town. Eagle Bluff is separated from the ones under consideration by a rolling prairie about 1 mile wide. From the highest point the whole of Eagle Bluff may be seen, having a sky-line outline somewhat as follows:



The general level of the valley between the two bluffs is seen to be fully 20-30' higher than the top of the white sandstone of the western base, none showing along the eastern base. Above the gray sandstone in the diagram is a distinct, persistent band of lignite or carbonaceous clays, which may be traced all through the bluffs to the east, gradually dipping lower until it apparently disappears at the foot of the bluff just below the reservoir above (S.) of town. While it is difficult to follow this lignitic band with certainty, it appears to be the same throughout! At the point of the bluffs where they approach nearest to the railroad - about a mile SE of town, the lignitic band is only about 25-30' above the base of the section, and is locally thickened to nearly 10', consisting of a foot or more of quite good coal at the top and alternations of chocolate-colored and lighter carbonaceous clays. No determinable plants could be found in this 10' band, but in the soft yellow sandstone [Lot 4.7] just above I found numerous beautifully preserved leaves of several species. One long, narrow sharply serrate leaf probably of Quercus; a lanceolate entire leaf probably Laurus; and a narrow entire leaf of Salix. A small scrap of a conifer also noted, this probably a Taxodium. They seem to be the same species as many I have collected in the top of the white sandstone yesterday. They do not appear to be Ft. Union! This leaf horizon is probably 50' or more above the top of the white sandstone.

About 25' below this horizon Dr. Peale got a few fragmentary plants in the local band of lignite - one probably Viburnum.

The yellow sandstone from which I collected the above mentioned plants apparently does not appear in the section of the bluffs back of town, or if so is at the very base.

July 20. To day visited Iron Bluff, reaching a point some 12-15 miles above Glendive. Followed the basal white sandstone from the point nearest town (where plants were collected July 18, q.v.) all along the north side of Eagle Bluff and for many miles beyond in connecting bluffs. This is certainly very persistent and conspicuous, in some places being capped by the thin dark-colored lignitic band, but this is often absent or so small as not to be visible at our distance from it. Toward the S.W. this sandstone appeared to become more yellowish, possibly due to change in materials composing it, but in the main it appears a very conspicuous feature.

At a point about opposite the Hospital ranch found the Ft. Pierre for the first time, consisting of the usual dark - almost black - clay shales with limestone concretions packed with marine fossils. Made only small collection of shells, just sufficient to identify the horizon. These shales appear to be 50-60' feet thick, but we did not see the base with certainty. Above these Pierre shales we note the yellow sandy and shaly sandstone of the supposed Fox Hills, here probably 60-70' thick. Looked carefully but found no evidence of plants other than indeterminable fragments of stems, bark etc.

From the above point started for the real Iron Bluff which may be seen for miles, the conspicuous feature being the red, burned beds above coal. By misadventure we got on the road to Miles City and passed entirely through the western limb of the sharp anticlinal fold into the high rolling table land beyond. From this point we walked along the divide (N.) to the railroad, where the bluffs end at the river and the railroad has helped make the features conspicuous by cuts. Our object was to study the sharply tilted beds beyond the crest of the uplift and the point at which the true Ft. Union overlies the dark beds. The true Ft Union so far as we could determine begins in beds just below the burned-out beds, for here found Thuya interrupta, Populus amblyrhyncha etc.

As Professor Ward made extensive collections at this place in 1883 we did not attempt to duplicate them, but collected from the lower 50-60' of beds finding them typically Ft. Union with Sapindus affinis, S. grandifolius, Populus, Aristolochia &c. Did not note the slightest evidence of a break between the so-called somber beds and those carrying typical Ft. Union fossils. Beyond the crest of the fold the beds dip sharply (measured 28° in places) but in a surprisingly short distance they have become nearly or quite horizontal again. So abrupt is this flattening out that it leads to the suspicion that the upper beds may not be conformable, but this we did not have time to investigate.

July 22. Today made a trip of some 8-10 miles below Glendive on the south side of the Yellowstone for the purpose of tracing if possible the transition between the somber beds back of town and the typical plant bearing Fort Union. In this we were only partially successful, since we did not find the actual point of contact though we were in beds undoubtedly higher than those back of town; The beds back of town dip gently to the E. or N.E. and it appeared possible to follow them until they became lower than the beds we studied today, but it is very difficult to be positive of the continuity of any ~~bed~~ horizon in these beds since they change so rapidly in character.

At the farthest point reached - a mile or more below the Harpster ranch in the river-front much scoria from burned coals, coal. Found plants at two points in these bluffs, 1st just under the highest bed of burned out material collected half a dozen examples of a species apparently new. It is hastate or deeply cordate and unequal-sided; suggests Polygonum.

At a point considerably lower than the above mentioned bed and lower down the bluff, found beds of coal unburned and

no determinable plants.
In the bluffs above the Harpster ranch - we observed a heavy bed of coal which has been burned out in some places. About 15' above the coal is a soft friable grayish S.S. which is absolutely filled from top to bottom (it is 20-25' thick) with a single species of Platanus, viz P. Raynoldsii. No matter where the S.S. is split beautifully perfect leaves appear, but the material is so soft that there is little probability of getting it in safely.
In clay shales just to the top of the sandstone found dicotyledons. e.g.: Populus arctica, Viburnum sp. Platanus sp. etc etc.
At a point about 4 miles below Glendive found plants in clay in bluff along the road. Obtained Populus arctica and a small conifer, probably a Taxodium.

Jul 23. To day made a long trip up Lower Seven Mile Creek going up the creek a distance of 8 or 9 miles from its mouth, and overlooking country for 8 or 10 miles further. The old Gleason's ranch (now the Seeds ranch) was one of Professor Ward's localities for what he called his Clay Marls or lignite beds. We went to this ranch but failed to find any of Ward's points, so we probably in the wrong place, or we could not have missed his things. In going down the river before turning off to go up Seven Mile it is possible to note the trend of the beds south of town and the gradual dip which carries them under. We could see that probably half of the beds studied above the Harpster ranch were above the top of the [illegible] beds. Following up Seven Mile the same thing occurred; the dark shales & clays gave place to yellow sands and sandy clays with no lignite except at the very [illegible] the end of the creek.

At the Seeds ranch we began practically at the creek bed and continued up to the top of the bluffs or alt. 300-400', all yellowish sands and sandy clays and sandstones. At a point about 250-275' below the top of the bluffs observed large numbers of sandstone concretions that have weathered out and now lie on the surface. They are mostly long, cylindrical or slightly flattened and resemble large tree trunks. They appear exactly similar to certain concretions observed in Converse County, Wyoming, and in about the same relation to the Ft. Union.

From the general upper line the bluffs rise 200' (Peale has section), the uppermost member being a massive light yellow soft sandstone (All summits capped heavily with glacial gravel). Just above base found a few very badly preserved shells. About 40' below the other S.S. found beautifully preserved plants in a brownish clay. The species noted were Populus cuneata, P. arctica, P. amblyrhyncha? P. Zaddachi? These clays were filled with leaves but hard to get out.

At a point about 3 miles down from the Seeds ranch and at least 100' feet lower than the last plants found a dark carbonaceous clay containing Sequoia Nordenskiöldi and a Taxodium with fragments of dicotyledons.

As the result of this trip we passed, without apparent break, from the dark lignitic beds of [illegible] up into at least 300' feet of overlying yellowish sands, clays and sandstones. There is absolutely no possibility of these being the highest beds of the Ft. Union as stated by Ward — on the contrary they are the very lowest! These conspicuous yellow bluffs could be seen for 8-10 miles north of the point we reached and no change of character noted.

July 24. Glendive – Mont.

To day visited and collected from the S.S. mentioned as collected from on July 19 [Lot No. 47], and secured additional material, but probably nothing different from that obtained previously.

In beds 50' below this point and practically at the base of the exposed section obtained a few plants from a soft SS over a thin band of lignite. There were large leaves of Platanus a foot broad as well as many of smaller size. Also leaves of Viburnum, Sapindus etc.

In the afternoon Dr. Peale made a trip along the west side of Eagle Bluff, following the broad white sandstone which persists for long distances, nowhere being over 50' in thickness. It is usually capped by a thin band of impure lignite or carbonaceous clay. He found a complete section including about 200' of Pierre, 150'± of the yellowish sands and sandstones of the supposed Fox Hills, then the 30–50' of white sandstones mentioned above. See his notes for details.

July 25. Notes on geology between Glendive and Miles City as noted from train.

Beginning at Iron Bluff it is to be observed that the effects of the sharp fold at that point disappear — or apparently so — within a very short distance within less than a mile. The beds of the Fort Union here again become nearly or quite horizontal, and the country flat and rolling as far as Marsh. At Marsh while the country is also flat, small exposures appear which consist of yellow sands and sandstones, suggestive of those observed on 7 mile Creek.

In the vicinity of Conlin the country becomes rougher and bluffs of yellow sandstones etc. probably 200' high appear. These seem to be similar to those observed on upper 7 mile Creek near the Sidney road. They are underlain by blackish carbonaceous clays etc. suggestive of the somber beds, and on the lower benches many large SS. concretions, like those noted at the Sidney road, were observed. Before reaching Fallon the country again becomes open and flat.

At Fallon the bluffs on the opposite side of the Yellowstone become prominent, consisting of some 200' of yellow sandstones etc., similar to those mentioned above. Beyond the point where the C.M. & St. P. road connects with the N.P. there are heavy beds on the N. side of the river which appear similar to those above Fallon, viz: lighter yellow sandstones etc.

At Terry the bluffs along the river are evidently Ft. Union, consisting of the usual light yellow sandstones etc., while on the N.P. railroad side of the river the beds seem to be lower, being darker and consisting of carbonaceous clays etc.

At Blatchford and Zero the bluffs are back from the railroad ~~and~~ both sides of the river, though just beyond the latter place the lower somber beds appear to be the ones in evidence.

In the vicinity of Shirley the beds on the opposite side of the Yellowstone appear at top to be the darker or sombre beds, consisting of the usual dark carbonaceous clays etc, with the familiar yellowish sandstones on top.

Again from Fusler the sombre beds are also in evidence.

Briefly summarized my idea of the conditions are as follows: The highest beds above the sombre beds are probably to be found just beyond Iron Bluff, but they soon disappear giving place to conditions very similar to those observed below Glendive and up 7 miles back, viz: the sombre beds in varying thickness at base and overlain by some 200-300' of the light-yellow sandstones etc of the lower portion of the so-called true or more typical Fort Union, the latter in many places showing burned out beds of scoria.

Miles City, Montana. In afternoon of same day went out to Mr. A. J. Collier's camp, located about 18 miles E. of Miles City, near the Ekalaka road. This trip confirmed my impression of the conditions observed along the railroad bet. Glendive & Miles City. As soon as the bluffs showing good exposures are reached 4-5 miles N.E. of the city it is seen at once that they are altogether in the sombre beds, being similar in a general way to the beds so well exposed back of Glendive. Some 200' of these beds appear to be exposed, but soon they begin to be capped by the characteristic yellow sandstones etc of the lower typical Ft. Union, these in turn extending up through some 200-250' of beds with almost always a bed of scoria at the top.

July 26. 1907. Collins Camp 18 miles E. of Miles City.
In forenoon visited some bluffs near camp passing first over some dark carbonaceous clays – in places bearing stems and misc. fragments – up into the light colored sandstones and clays. This bluff – as are all in the vicinity – has the burned out ends at the top. It did not contain plants, but in a shaley sandstone about 25 feet above the top of the somber beds found a number, such as Asplenium tenerum, Sapindus, Viburnum, Taxodium occidentale &c. [K.4]
In afternoon went down to the R.R. and about 6-7 miles N.E. of camp, but had no time to look for fossils. Followed the coal outcrops as well as possible. There appear to be only about 3 seams of coal in this part of the country, all confined to the upper portion of the somber beds. The lowest is about .. feet below the base of the yellow more typical Fort Union, and is rarely exposed. The next and thickest is about .. feet above the lower and in places is 10' thick, only about 2-3' however, being good coal. Some .. above this is a thin seam 4'± thick. [Lot No. K.3].

July 27. Collins' Camp – Klondike's ranch about 18 miles E. of Miles City –

This a.m. worked in the side of a bluff opposite the ranch in a bed of hard concretionary sandstone (2½' thick) in the midst of dark carbonaceous clays. This bed is about 20' above the base of the exposure and probably just below the base of the yellow Ft. Union & contains great numbers of stems, (Lot No K.4) and a few other things, among them "Onoclea" sensibilis fossilis, Equisetum stems and another Sapindus obtusifolius? large heart-shaped leaf, and small leaf like (or suggesting) leaves from under lower scoria bed at Herfoster's below Glendive.

In afternoon visited bluffs just east of camp, collecting a fine series of plants from the top of a small butte, the position being the very lowest beds of the lighter colored beds of more typical Ft. Union. I found Sapindus, Viburnum, Populus, a new species evidently a Nelumbo or Castalia, and a few fruiting heads of Ward's problematic organism! This appears to be Ward's Sapindus bed. (Lot No. K.1)

July 28. Collected a few scrappy plants from the scoria beds on the top of one of the high buttes ½ mile E. of camp. The genera Viburnum, Populus etc. (Lot No K2) are represented.

July 29. 1907. To day made long trip up the valley of Cottonwood Creek and down main stream nearly to the EZ ranch with Wegemann. Searched in many places for fossils but found them only below the main coal seam. In one place found Populus cuneata Taxodium occidentale etc. At another (Wegemann has picture of place) locality where the coal is locally very thick found what appears to be Trapa? microphylla with Taxodium, Populus. At the furthest point reached where the coal bed shows both burned and unburned portions side by side (W. has exposure of this too) found the dark clays just below full of plants including several dicotyledons, Trapa, Taxodium etc etc.

Going down the main stream probably 3 or 4 miles below mouth of Cottonwood visited the lowest coal bed in that region, and although the clays below the coal are full of stems and fragments, found no good plants.

On this trip secured exposures of good bluffs in which the contact between the Somber beds and the yellowish sands etc of the upper beds is beautifully shown.

July 30. To day went with Collier to visit a point about 6 miles N. of Klondike ranch and the same distance East of Tusler. At a point in the section which seems to be about the contact between the somber beds and the lighter beds above and in a low sandstone ledge which caps a series of low grass-covered hills we found what appears to be a conglomerate. For a distance of perhaps a quarter of a mile there is a thin layer about 6 inches thick in which there are angular fragments of sandstone imbedded in matrix of nearly or quite the same kind. If this were a real conglomerate it would argue for an unconformity but it hardly can be so classed. It appears as though there has been some slight local disturbance which tore up or displaced a little of the soft sandy material which was immediately redeposited. Collier has samples of this 'conglomerate'.

About 1 mile N. of this point the bad lands begin, leading down to the Yellowstone. In a ravine about 100' below the top of the Lance beds collected a pretty good lot of plants from hard concretions as well as from soft beds immediately underlying (K No 7).

July 31. Came from Collier's Camp to Miles City. Observed the beds on the way, all after reaching the divide being in the Lance beds.

Aug. 2, 1907. Made trip out from Miles to a point 8 E. of town. Near the old abandoned Kenny coal mines I found a few poor plants in a carbonaceous clay at a point about the same level as the opening to the mines. Found Populus ~~arctica~~ cuneata, a Viburnum and one other. (K. No 11)

Then went over to Signal Butte and at a point just above the second coal (probably No 16 of Leonard's section) found fine plants in a massive gray sandstone that is 25-30' in thickness. Found Platanus, Sapindus, 2 sp. of Populus, Taxodium & what is probably a new species of dicotyledon. (K. 12).

Aug. 4. Visited point about 6 miles E. of Miles City, where Hayden is supposed to have collected his plants called Fort Union but found absolutely nothing. The horizon is in the Lance beds a little above the opening of the Kircher coal mines.

Summary of results noted about Collins Camp. Two sets of beds are present - the somber beds and the overlying yellowish sandy ~~material~~. These are typical Fort Union. The total thickness exposed is 700-800' of which about 500' belongs to the somber beds and the remainder to the yellowish upper beds. The base of the somber beds is not present, nor is the top of the yellowish beds. There is absolutely no evidence of a break between them and many plants run through both.

Aug. 5. Notes on geology between Miles City & Billings, Mont.
Conditions observed about Miles persist with little change for some miles, probably as far as Horton. At Forsyth there is a gray SS there ~~[illegible]~~ at base with yellow massive SS on top; The gray SS soon disappears and the massive yellow SS is probably 30-40' thick, coming down to line of track.
At Howard there is an abrupt change in appearance and vegetation. There is an abrupt line of pine trees on the somber beds and not one on the lower beds. The line of bluffs carrying the pines appears far back.
Between Howard & Sanders there appears to be a broad low anticline, with three flat-topped terraces of black beds probably of Pierre, but at about Myers the Pierre disappears and the same yellow sandstone again comes in ~~[illegible]~~ being covered with the pines. The black of the Pierre occasionally shows at the very base. At Big ~~Timber~~ Horn the lower (Pierre?) has entirely disappeared and the bluffs consist of massive sandstones.
At Myers observed heavy yellow SS on top probably 20-30' thick, then banded beds of sands and clays, then heavy sandstone at base. This should apparently be the Fox Hills sandstone but may possibly be the lower portion of the somber beds which are here lighter in color

These heavy SS bluffs are all pine-clad. One mile W. of Myers the Pierre again appears beneath the above mentioned beds, the black beds with concretions showing beside the track. No unconformity between the heavy SS and the underlying black Pierre could be detected and the exposures are exceptionally good. Just below the heavy SS. ~~and~~ are beds of sand and clay in thin bands, or sometimes only sands or only clay.

Just below Bull Mountain station the Pierre appears to be coming in again, with flat-topped rolling ridges without trace of pines, though an occasional sandstone appears at base it may be that the dark beds are not those of Pierre.

At Pompeys Pillar the undoubted Pierre has come in again with the same terraced slopes, without trees, while the massive SS bluffs with pines are in the far distance. On opposite side of the Yellowstone the SS still shows in places.

Aug. 28. 1907. Livingston and vicinity.

Reached Livingston this afternoon and was taken by Dr. Peale up on the bluffs just north of town. The Livingston beds are very much in evidence, and consist of an enormous thickness. Across the river (Yellowstone) just at the wagon road bridge the top of the Laramie may be noted, and there must be at least 500' of Livingston beds filling the valley before we come to the bluffs north of town. Beginning at the irrigation ditch near the east end of the first ridge the section shows good exposures, with a dip of from 25-30° to the north.

Plants in lowest bed (Peale's first bed)
Populus arctica as identified by Lesq.; Ficus artocarpioides? Populus cuneata, Taxodium occidentale?

Plants in second bed (K's. bed)
Ficus trinervis or Cinnamomum sp.
Viburnum marginatum

Plants in upper, yellow sandstone, about 100' above base of exposure.
Platanus large leaves probably
P. Raynoldsii

16 8
5
80

K.11. 2 miles E. of Miles City, Montana. Low bluffs near the Kinney coal mines and about same level as the opening of the mines. Aug. 1, 1907.

K12. Signal Butte, 8 miles S.E. of Miles City, Montana. Just above the 2d workable coal vein. (No 16 of Leonard's section. ~~this~~) -

K.13. About 20' above base of so-called Judith River beds in Scribner section. Col. by Knowlton Aug. 13, 1907.

K14 Sage Creek about 3 m. below Cody, Wyo. In Laramie just below Conglomerate. No. .. of Shoshone river sect. Col. Knowlton & [illegible]. Aug. 14, 1907.

K 15. Shoshone river canon 3-4 miles below Cody. Wyo. 100' above conglomerate at base of Ft Union section. No 88 of local section.

K 16. Shoshone river canon 5-6 m. below Cody-Wyo. about middle of Ft. Union sect. No. 88 of local section.

K17. Shoshone River. Canon below Cody Wyo. Eagle formation.

K18. Shoshone river sect. below Cody Wyo. near top of Ft. Union

K.19. Bridger, Mont. Thin ss. "immediately above lower coal seam in the Eagle - Opp. fire house in the coal town". Aug. 17. 1907.

K.1. Klondike ranch. 18 miles E. of Miles City, Mont. Sect. 24,
Basal yellow Ft. Union beds. July 27.

K.2. Same loc. as last.
Scoria, tops of highest bluffs. July 28.

K.3. Same loc. as last 2.
2' hard layer in carbonaceous clay about 100' below top of Somber beds.

K.4 Same loc. as last
Bluff back of camp. about 25' above base of lighter beds. July 27.

K.5. Same loc. 5 miles E. of ranch, just below lowest coal of region. July 29

K.6. Klondike ranch, 18 miles E. of Miles City – valley of Cottonwood Creek, just below the main coal vein of the region – the so-called big dirty. July 29.

K.7. 6 miles N. of Klondike ranch. or about 7 M. E. of Tusler, Mont. (Sect 33. T. 9 N. R. 49.) Beds about 100' feet above top of Somber beds. Altho. different in appearance this material all came from within 3'. July 30. 1907.

K.8 Shells. 3 M. S.E. of Miles City. Wagner – Carrender.

K.9 6 M. N.E. Miles City, Mont.
15' above the Kirsher coal bed.
Howell, Collector.

K.10 7 M. S.E. Miles City, Mont. Yellow beds about 100' above base.
Collier & Howell cols.